Quality Assurance Project Plan Draft 9/30/15
U.S. EPA – NHDES?
Project Title: Quantifying the density of Asian clams (*Corbicula fluminea*) within and beyond the influence of the thermal discharge of a power plant
Project Leader(s): Eric P. Nelson
Principal Investigator(s): Amy Smagula**,** Hilary Snook

A Project Management

A1. Approvals

Project Title: Quantifying the density of Asian clams (*Corbicula fluminea*) within and outside the influence of a power plant's thermal discharge.

Management Approvals:

Signature indicates that this QAPP is approved and will be implemented in conducting the research of this project

Ken Moraff ----------
Division Director *Signature* *Date*

Eric Nelson ----------
Project Leader *Signature* *Date*

Hilary Snook ----------
Principal Investigator *Signature* *Date*

Amy Smagula ----------
Principal Investigator *Signature* *Date*

Quality Assurance:

Signature indicates that this QAPP meets the quality requirements of EPA.

Nora Conlon----------
Region I Quality Assurance Officer *Signature* *Date*

A2. Table of Contents

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A3. Distribution List: The following individuals will receive a copy of the approved QAPP as they are part of the project team:

Eric Nelson, Phil/Dan/Jean, Chuck Protzmann, Region 1
Hilary Snook, OEME
Amy Smagula, NH DES
Nora Conlon, QA Manager, Region 1

A4. Problem Definition/Background: The introduction and proliferation of invasive species represents a significant threat to indigenous species and the habitats in which they live (Morgan et al. 2003, Simard et al. 2012). Some invasive species can also cause substantial economic impacts due to their negative effects on native commercially-important species, impacts to recreational activities (e.g., fishing, swimming) and foul the cooling water systems of power plants and other industries. Native to southeast Asia, Asian clams (*Corbicula fluminea*) were first reported in the U.S. in 1938 when they were discovered in the Columbia River Basin, Washington (Simard et al. 2012). Described by McMahon (1983) as one of the most invasive species in the world, it has high growth rate and fecundity, early maturity, and high dispersal potential. It is a self-fertilizing hermaphroditic bivalve that can produce up to 570 juveniles per day (McMahon and Bogan 2001). As described in Caffrey et al. 2011, *Corbicula* is known to competitively impact native macro-invertebrate communities, significantly reduce phytoplankton biomass, and alter benthic substrates.

Although *Corbicula* has spread throughout much of the U.S., up until relatively recently it was widely thought that exposure to a prolonged period of temperatures below 2°C and winter ice formation limited their distribution in northern latitudes (Mattice and Dye 1976). In fact, the appearance of *Corbicula* in New Hampshire was first reported in 2011 (Personal com. A. Smagula, NHDES), and their identification in Hooksett Pool of the Merrimack River in Bow represents the northern-most reported location of *Corbicula* in New Hampshire. Their presence and abundance in Hooksett Pool appears to be related to the discharge of heated cooling water from Merrimack Station. Published studies conducted at two other power plants in the Northeast – one on the Connecticut River in Connecticut, and one on the St. Lawrence River, in Quebec, Canada – have found relationships between the presence/abundance of *Corbicula* in the waters affected by the plants' discharge of waste heat compared with areas outside the influence of the plants' thermal plumes.

The results of this study will be included with other existing information on the presence of *Corbicula* in the Merrimack River to improve our understanding of the power plant's influence on this invasive species. This, in turn, will be used to further evaluate the plant's ability to meet state and federal water quality standards, and its NPDES permit requirements, as they apply to protecting the resident biological communities.

A5. Project/Task Description: This project has three main objectives:

(1) The first objective is to further assess and document the presence and abundance of *Corbicula* in relation to the thermal discharge from Merrimack Station. Prior work by the plant's environmental consultant, as well as work conducted by NHDES and EPA, revealed *Corbicula* to be present within and downstream from the plant's discharge canal, but totally absent in areas directly upstream from the discharge canal. Corbicula was also absent at sampling locations in Garvin's Pool, the impoundment immediately upstream from Hooksett Pool;

(2) The second objective is to assess the abundance of *Corbicula* relative to native epifaunal and infaunal macroinvertebrates. This will allow us to further evaluate *Corbicula's* capacity to displace native invertebrates, including mussels. According to benthic grab studies conducted in 2011 by the plant's environmental consultant, Normandeau Associates, *Corbicula* was the dominant species at most benthic sampling locations (14 of 18) at or downstream from the discharge canal, but was not dominant at any locations (0 - 6) upstream from the discharge canal (Normandeau 2012);

(3) The third objective is to examine size differences in *Corbicula* relative to their proximity to the mouth of Merrimack Station's discharge canal in order to assess differences in growth rate, as well as age-class structure. This will provide us with a better understanding of how proximity to the plant's thermal discharge canal - alone or in combination with other factors – affects the clam's age and growth rate.

A6. Project/Task Organization:

Eric Nelson, EPA Region 1 – Project Leader: Eric is responsible for coordinating the sampling efforts in consultation with the Principal Investigators. He will also be one of the divers involved in collecting benthic samples, and will manage sampling operations. He will maintain the official version of the QAPP.

Hilary Snook, EPA Region 1, OEME– Principal Investigator: Hilary's responsibilities will include the topside supervision of the field collection effort for biological samples to be processed for identification and enumeration, as well as sediment samples collected for grain size analysis. Hilary will also be operating a small boat, assisting with locating sampling sites, assisting divers, and transporting samples to the Chelmsford Lab for processing and storage.

Amy Smagula, NH DES– Principal Investigator: Amy will assist with benthic sampling and collecting attribute data (e.g., sample location coordinates, water depth and temperature), Amy or another NHDES employee will operate a small boat, and assist the divers, as needed.

Jean Brochi/Phil Colarusso, EPA Region 1– Jeannie/Phil will serve as Divemaster when not diving. As a diver, s/he will be involved with sampling and taking underwater photographs of the operations.

Chuck Protzmann, Dan Arsenault EPA Region 1 – Chuck and Chuck will serve as divers and will be involved with collecting samples and taking underwater photographs.

A7. Quality Objectives and Criteria for Measurement Data:
We will conduct dive surveys at each designated sample location in Hooksett Pool. Quality Criteria have been established for all aspects of this project that involve the generation of data. This includes the collection and processing of biological and sediment grain-size samples, as well water depth, water temperature, and sample positions. Some specifics on measurement quality criteria are given in Table 1.

A8. Special Training Requirements/Certifications: This work requires the use of SCUBA diving for the collection of samples. Three of the members of the project team are EPA-certified divers. All dive operations will be conducted in accordance with established diving safety protocols detailed in EPA's Diving Safety Manual. All staff working in the laboratory will receive the required training that includes lab safety training, RCRA training (if applicable) and Emergency Action Plan training. They will also need to demonstrate proficiency with the methods to be performed.

A9. Environmental concerns and mitigation: As part of the field sampling effort, we will be collecting *Corbicula* and other benthic infauna and epifauna within the sample site using a 25.4 cm diameter plastic bucket with the bottom cut out (See Figure 1). Only minimal impact to the benthic community will result from the collection of 40 samples, and, based on previous sampling, most organisms collected are expected to be *Corbicula fluminea*. All native mussels collected will be counted, measured, identified, and photographed onsite, and then released. The capture of any brook floater (*Alasmidonta varicosa*) mussels will be reported to NHFGD (Mike Marchand) within 24 hours. EPA has obtained the necessary collection permit from NHFGD. If macro-invertebrates other than clams and mussels are collected, a 10% buffered formalin will be used to preserve that part of the sample. Any participants working in the field or lab to process samples will received the required training in order to make waste designations and properly store chemicals and waste material.

Procedures for cleaning the boats to prevent the unintentional tansfer/release of Asian clams into other waterbodies will be followed (i.e., clean, drain, dry).

A10. Documentation and Records: Upon final approval of the QAPP, the Project Leader will ensure that each member of the team will receive an electronic version of the document. In addition, during the time in the field, the Project Leader will have a paper copy of the final approved QAPP on site.

The Project Leader will be responsible for the field log during the field sampling effort. GPS coordinates recorded in the field will be recorded in the field log and also saved electronically on our GPS unit. Upon return to the office, the electronic data will be

downloaded to the Project Leader's PC and to a separate secure location on the Regional LAN.

Field data sheets will be composed of waterproof paper and will be appended to the field log. Upon return to the office, the sheets will be scanned or data entered into an Excel spreadsheet which will be stored on the Project Leader's PC and a secondary location on the Regional LAN. Examples are attached.

The field log and laboratory notebooks are tools to track sample integrity and record observations that may fall outside of the normal data requirements of the project. During the course of sampling or analysis, the quality of a sample may be compromised due to equipment error, human error or happenstance. The sample identification number, the date, the name of the person providing the information and a detailed description of how the sample may have been compromised should be recorded in the field log or the laboratory notebook.

This project is scheduled to be a one-year effort, however, there is a possibility that it will continue, and may include other environmental sampling parameters. A report will be completed based on the sampling results, and submitted to EPA and NHDES management. The report will also be shared with NHFGD. This report will contain a summary of the data, and will be retained on file indefinitely in case of an audit. Paper data sheets, lab notebooks and field logs will be retained for 20 years as required by EPA Records Schedule 503. Electronic data files can be retained on the Regional LAN system indefinitely.

B Measurement/Data Acquisition

Field methods for each type of sampling will be consistent at each site and throughout the duration of the project.

B1. Sampling Process Design (Experimental Design): Sampling will occur at locations upstream, in close proximity to, and downstream from the plant's thermal discharge canal, with an equal number of samples (20) collected within and outside the influence of the plant's thermal discharge. Previous sampling and diver observations by EPA and NHDES in Hooksett Pool have resulted in no specimens of *Corbicula* being found or observed at any location upstream from the power plant's discharge canal, so additional samples at these stations could either confirm our current understanding on the distribution of *Corbicula,* or provide new data possibly indicating an expansion of their distribution.

Field sampling

Sampling of benthic macroinvertebrates:

Samples will be collected by divers using a plastic 5-gallon bucket with the bottom removed. The outside of the bucket will be marked in centimeters from the bottom so

that the diver does not exceed 16 cm of penetration (See Figure 1). The actual depth of penetration (16 cm, or to refusal) will be measured to the nearest centimeter, and recorded by the diver on a dive slate. After each sample is taken, sample penetration depth data and other pertinent data will be transferred to a field data sheet on the support vessel. The surface area sampled using the bucket will be 0.05 m^2, and the total volume will be a maximum of 8,103.21cm^3, but will depend on the depth of penetration. Surface area will be converted to meters squared (m^2) by using a multiplier of 20.0. Once the diver drives the bucket down into the substrate to 16 cm (or refusal), he will carefully remove the material from within the bucket and transfer it using a plastic container (e.g., Tupperware) to another bucket. When all the material within the bucket has been removed down to the bucket's bottom lip, the bucket containing the sample will be covered and transported to the surface. At the surface, the bucket will be transferred to a boat where it will be sieved.

A sampling grid has been created with target sample locations identified so there is adequate representation both within and outside the thermally-influenced zone (See Figure 2). The approximate center of each sampling quadrant will be used to identify the general sampling location. When in proximity to the target location a weighted line with attached bullet float will be dropped from the boat. Once deployed, divers will inspect the location of the weighted marker to insure that the bottom is clear of obstructions that would prevent taking a sample. If the location is suitable for sampling, one diver will photograph the sampling location, and another diver will take the bucket sample. If the location is unsuitable (e.g., submerged log, rock or debris,) the marker will be dropped again from the boat until a location clear of obstructions is found. After the sample has been collected and transferred to the boat the divers will transcribe the sample depth onto the data sheet, as well as any other pertinent information. The location of the marker float will be recorded using differential GPS. The DGPS has an accuracy of approximately 3-5 meters when there is acceptable signal strength from a minimum of three satellites. Therefore, positions will only be recorded when they reflect a minimum of three satellites. Coordinates will be recorded in degrees, minutes and seconds to three decimal places.

At each sampling location, surface water temperature and water depth will be collected from the vessel using …check with Hilary.

B2. Sampling Methods Requirements

Detailed descriptions of the sampling methods are outlined in Section B1. Biological samples will be collected by divers via bucket sampler. Samples will be sieved on board using a 595 µm mesh sieve bucket. All clams, mussels, snails, insects, worms, etc., will be collected. Clams (*Corbicula fluminea*) is the only clam species expected to be present) will be separated from the rest of the sample and placed in another container identified with the sample number, location, date, and species. As described in Section A.9, all native mussels collected will be counted, measured, identified, and photographed onsite, and then released. Additionally, the capture of any brook floater (*Alasmidonta varicosa*) mussels will be reported to NHFGD (Mike Marchand) within 24 hours.

Corbicula will be placed in a zip-lock bag and stored on ice during the day of collection, and then transported at the end of the day to a freezer at the Chelmsford Lab for enumeration, measurement, photo-documentation, and longer term storage. All other macro-invertebrates will be placed in a labeled sample container, preserved with alcohol, and returned to the Chelmsford Lab for eventual identification and enumeration by a qualified benthic ecologist. Water depth, temperature and position data will be recorded electronically and manually, and downloaded at the earliest possible opportunity.

B3. Sample Handling and Custody Requirements

The sample handling and storage methods for these samples are listed in Table 2. Chain of custody procedures are not required for this project unless macro-invertebrate identification is conducted by a contracted service.

B4. Analytical Methods

Sample preparation and Analysis

B5. Quality control

Table 3 lists the quality control checks that are conducted for each of the instruments utilized. The quality control criteria used to evaluate the performance of the instruments is listed in Tables 3.

B6. Instrument/Equipment Testing, Inspection and Maintenance Requirements

The inspection and maintenance conducted on the instrumentation is listed in Table 4.

B7. Instrument Calibration and Frequency

Water temperature and depth will be determined using a (discuss with Hilary). Prior to sampling, the instrument will be checked and calibrated, as necessary, following owner manual requirements.

B8. Inspection/Acceptance Requirements for Supplies and consumables

Consumables required for this project include materials for sample collection, such as Ziploc bags, and supplies for the processing of samples.

B9. Data Acquisition Requirements (Non-direct Measurements)

We are generating all of the data for the project. If we find existing data that can be used, this QAPP will be modified to identify how that data will be handled.

B10. Data Management

Raw data obtained during the field collections will be entered onto standardized data sheets or into log books following standard QA protocols as described in ORD PPM13.2 *Paper Laboratory Records*, or in electronic files if measurement is automated.

Measures intended for use in subsequent manipulations and analyses (hereafter referred to as primary data) will be transcribed to electronic spread sheets (typically Excel) created and manipulated on personal computers. Records will be maintained of file names and contents. As appropriate, hard copies will be generated for storage in activity files kept by the Principal Investigators.

Whenever possible, transfer between data files and product files will be performed electronically to minimize errors of transcription. Written observations will recorded electronically by the Project Leader and double checked by at least one of the PIs. Standard commercial software packages (PowerPoint, Excel, WordPerfect, Word, etc.) will be used to develop graphical and tabular data presentations. As appropriate, hard copies of products with associated presentations of data will be generated for storage in activity files kept by the Principal Investigators.

Electronic copies of all computer files will be stored on Region I's network servers that are backed up daily onto tapes. All data manipulations will occur using the copy resident on the PC hard drive, with copies made to the servers. Hard copies of electronic data files will be obtained at the end of the study for archival purposes.

Modeling/database projects.

This particular QAPP does not qualify as a "modeling/database project" with regard to special considerations for external data since we will be collecting all data.

C. Assessment/Oversight

C1. Assessments and Response Actions

A number of assessment procedures will be implemented to ensure the quality of project products. These include:

1. Record keeping and data entry – All data entered into laboratory notebooks and data sheets will be double checked for accuracy by the recorder and a second individual. Similarly, data entered into computerized spread sheets will be double checked for transcription errors by the person entering the data.

2. Statistical procedures – As necessary, discussions will be held with OEME staff and other EPA staff familiar with sampling design prior to data collection to

ensure the appropriateness of planned statistical procedures and to ensure that such procedures are executed and interpreted correctly.

3. Internal and external peer review of manuscripts, presentations, and reports – In addition to review by immediate authors, OEME's policy regarding internal peer review of products will be followed. Finally, outside peer review (e.g., by EPA program offices) of special products may be requested by individual authors or by OEME management to provide input regarding research relevance and the quality of conclusions.

C2. Reports to Management

Reports on the progress of this research will be provided to EPA management, as requested. A final report will to management of both EPA and NHDES is expected by the end of the 2015 calendar year.

D. Data Validation and Usability

D1. Data Review, Verification, and Validation

The criteria used to validate data generated as part of this project are listed in Table X. The Project Leader will perform the data manipulation with verification provided by one or more of the PI's on the project.

D2. Verification and Validation Methods

In addition to these criteria listed in Table X we also assess data sets for outliers. Outliers will be defined as data points that may be 2 times the standard deviation from the mean of the dataset. If outliers are identified samples may be re-analyzed if they are still available.

D3. Reconciliation with User Requirements

The results from this research will be incorporated into a written report. Comments will also be requested on any reports and all comments will be addressed in the final reports.

E. References

Caffrey, J.M., S. Evers, M. Millane, and H. Moran. 2011. Current Status of Ireland's newest invasive species – the Asian clam *Corbicula fluminea* (Muller, 1774). Aquatic Invasions. Vol. 6, 3: 291-299.

Mattice and Dye 1976

McMahon 1983

McMahon and Bogan 2001

Morgan, D.E., M. Keser, J.T. Swenarton, and J.F. Foertch. 2003. Population dynamics of the Asiatic clam, *Corbicula fluminea* (Muller) in the lower Connecticut River: establishing a foothold in New England. J. Shellfish Research. 22: 193-203.

Normandeau (Normandeau Associates, Inc.) 2012. Comparison of Benthic Macroinvertebrate Data Collected from the Merrimack River near Merrimack Station During 1972, 1973, and 2011. 17pp.

Simard, M.A., A. Paquet, C. Jutras, Y. Robitaille, P. Blier, R. Courtois, and A.L.Martel. 2012. North American range extension of the invasive Asian clam in a St. Lawrence River power station thermal plume. Aquatic Invasions. Vol. 7. 1: 81-89.

Figure 1: Sampling bucket with transfer container

Figure 2: Sampling grid for areas within and outside the thermally-affected zones. Blue dots represent samples within ambient zone, and pink dots are located in the thermally-influenced zone. The red line depicts the approximate limit of ice cover (north and east of) based on an aerial photograph from March 5, 2014.

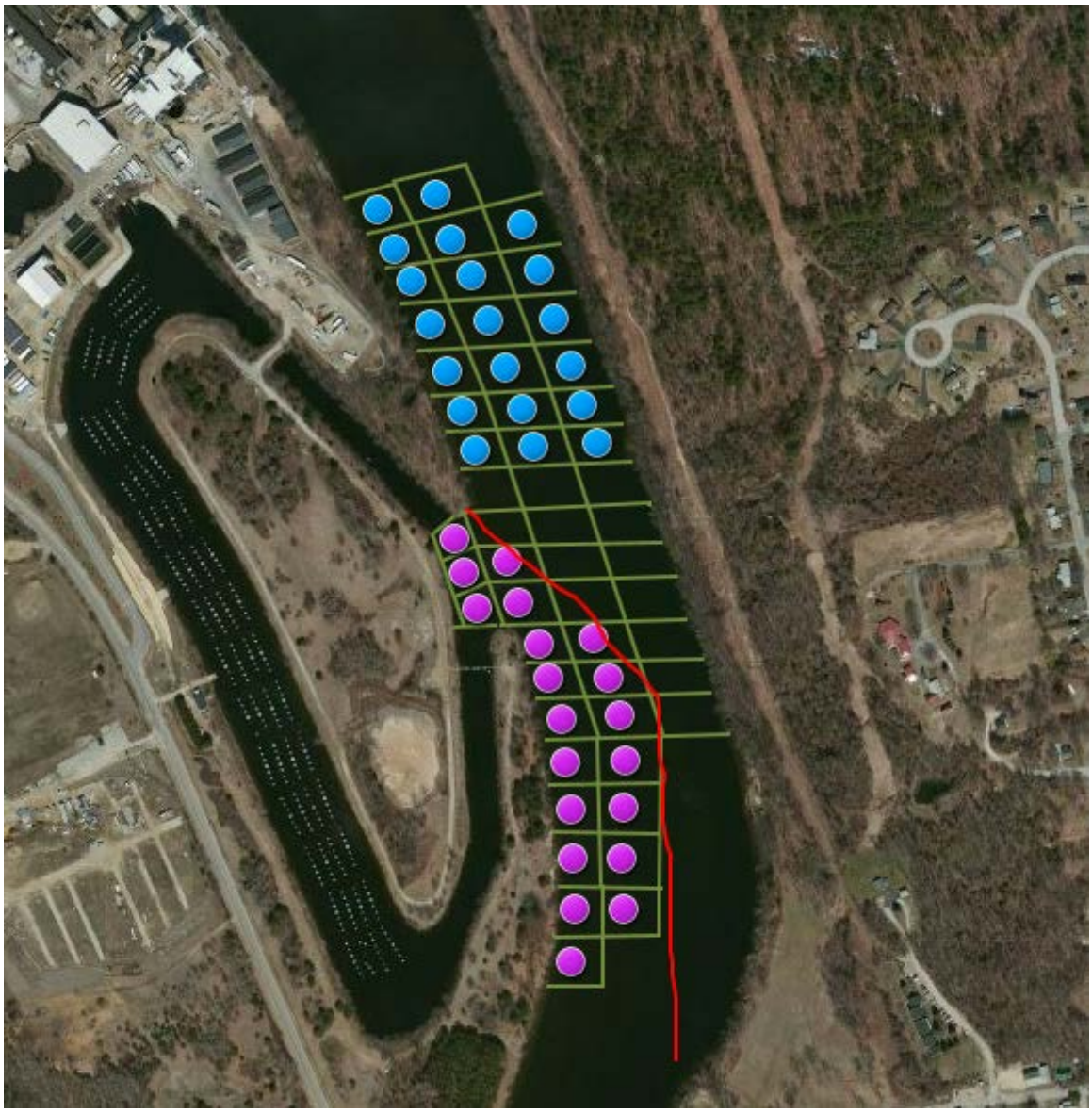

Table 1: Measurement Quality Objectives and Criteria

Parameter	Units	Expected Range[1]	Accuracy (%)	Precision (%)	Complete (%)
Water Depth	meters	1-4 m	+/- 0.1m	+/- 0.1m	100
Sureface Water Temperature	± 0.1º C	10-24º C	+/-0.5° C	+/-5	100
Sample location - GPS	D,M,S.SSS	n/a	+/-5 m	+/-5 m	100
Sample Depth	cm	1-16 cm	+/- 1 cm	+/- 1 cm	100

Table 2: Sample collection, handling and preservation activities

Sample Type	Parameter Measured	Sample Container	Minimum Sample Size	Preservation Method/ Storage
Asian clams	Identification, enumeration, shell length	plastic bags	n/a	Ice in field, store in freezer at -20°C
Mussels	Identification, enumeration	Relaease after identification and enumeration	n/a	Ice in field, store in freezer at -20°C
Other macro-invertebrates	Identification, enumeration	Sample container	n/a	Alcohol

Table 3: Quality control checks for instruments

Instruments	QC Check	Frequency	Data Summary	Acceptance Criteria	Action if values are unacceptable
GPS Unit	Side-by side comparison with second unit; Fix on known location;	Beginning of each sampling day		Within 5 meters of each other and fix	Re check
	Satellite check	After each fix taken		minimum of 3 satellites available	Retake fix
Surface Temperature					
Water Depth					

Table 4: Preventive maintenance

Instrument	Frequency	Preventive Maintenance